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B2L LCEC
U1S S1573 S1915 S1958 S2055

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GB 1369612 A GB 0913685 A

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UK CL (Edition M) B2L LCEA LCEC
INT CL[5] B05C 5/02 , B05D 1/00 1/26

(54) Coating pipes, cables or hoses

(57) A method of providing a protective skin around a core structure comprising the application of one or more lines of fluent covering material to the surface of the core to form an even and regular coating followed by uring and drying. The lines may be of helical or longitudinal form. The covering material may be a two part polyurethane composition. Apparatus adapted to apply helical windings 28 of covering material to a core 20 may comprise rotating applicators 24, 29 and spreaders 32. To apply longitudinal lines the applicators and spreaders (84, 86, Fig. 5) are stationary.

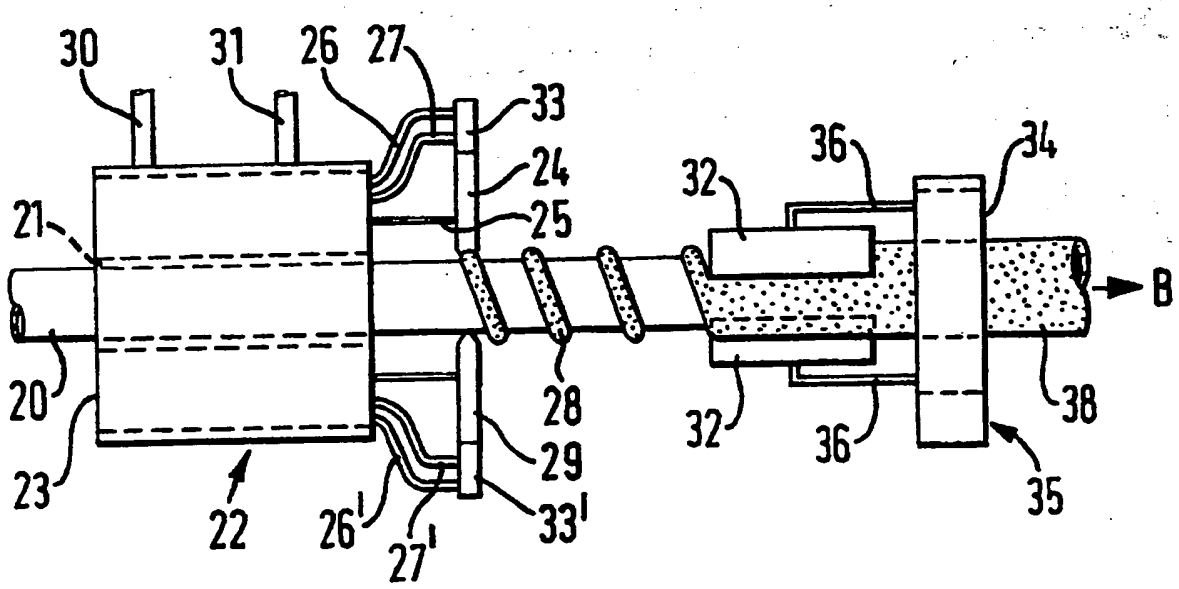

FIG. 2

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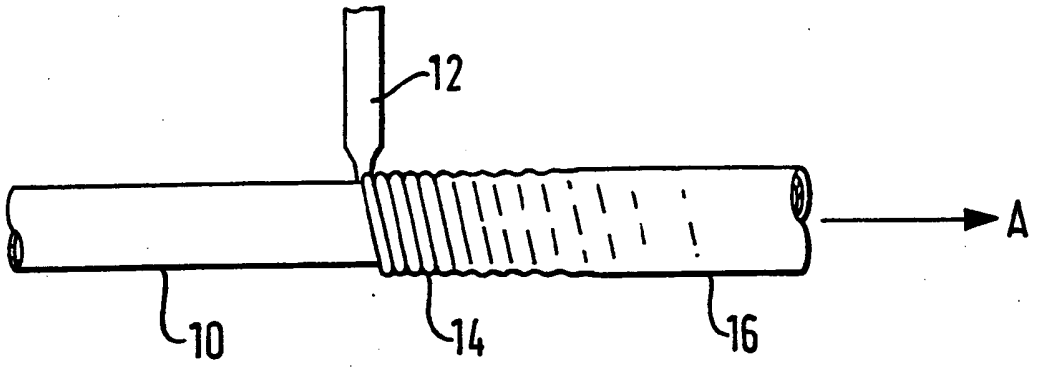
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FIG. 1

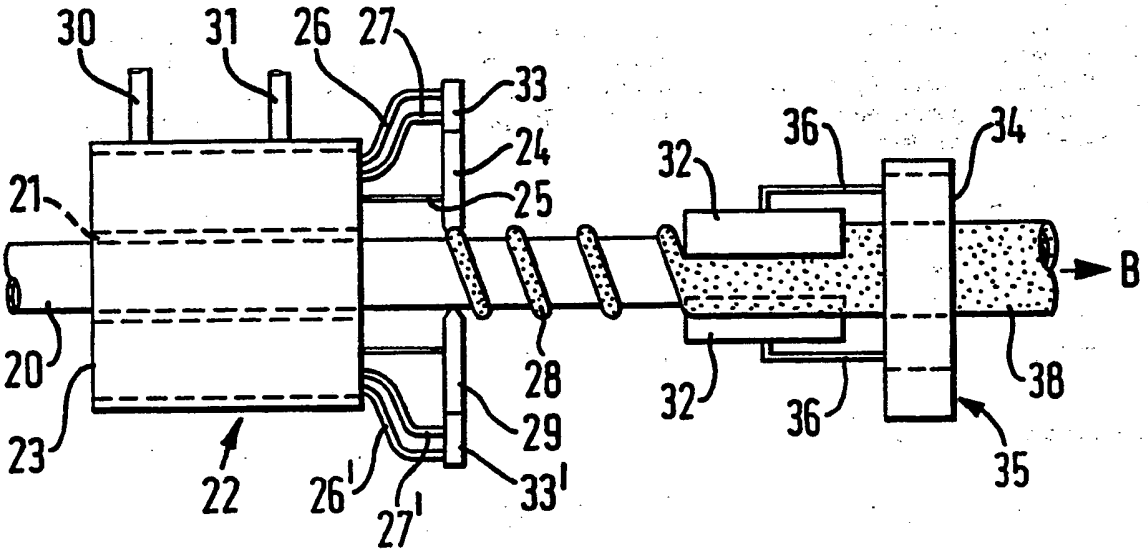
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FIG. 2

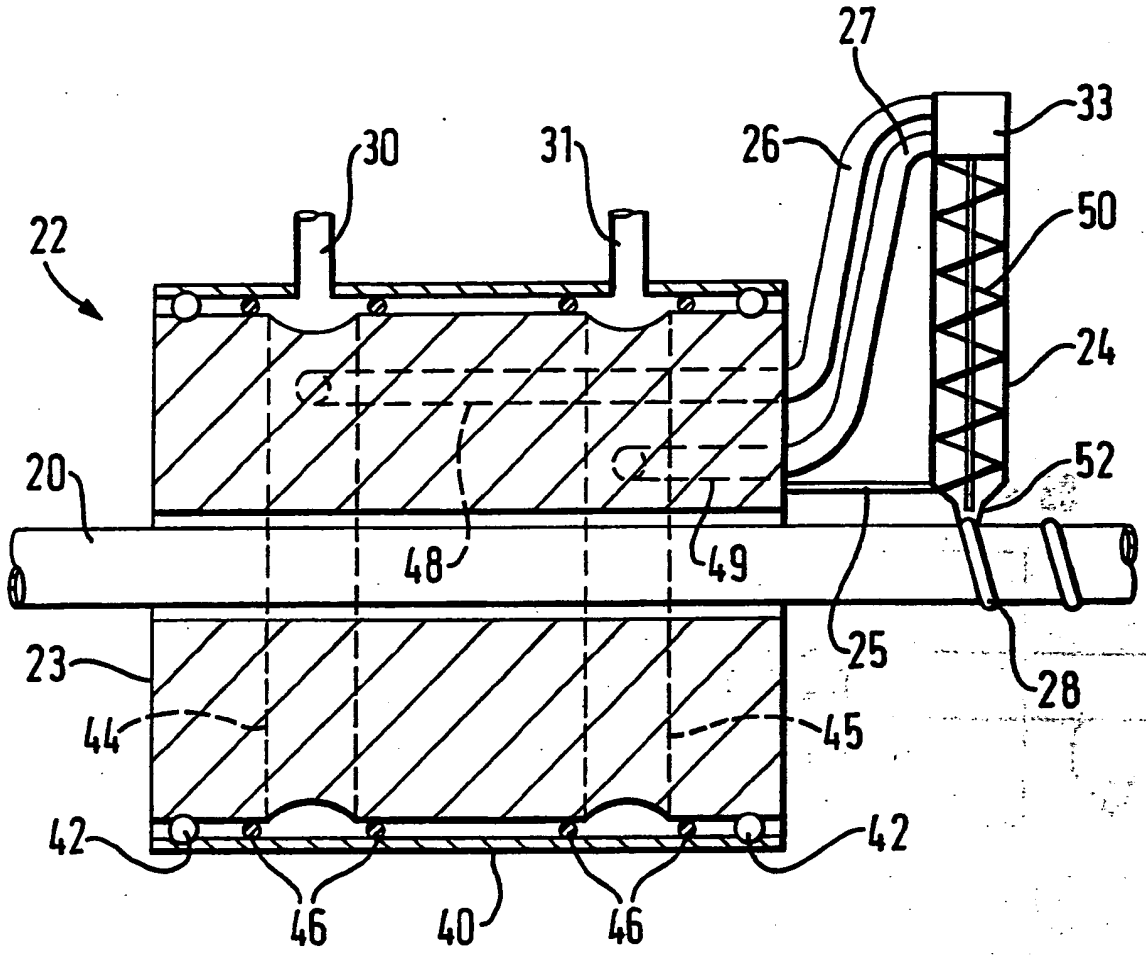
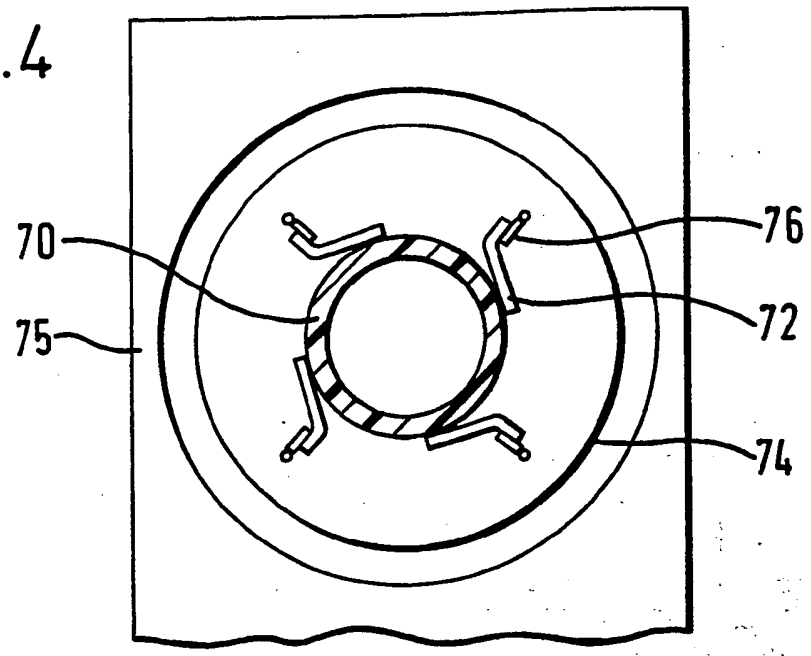


FIG. 3

FIG.4



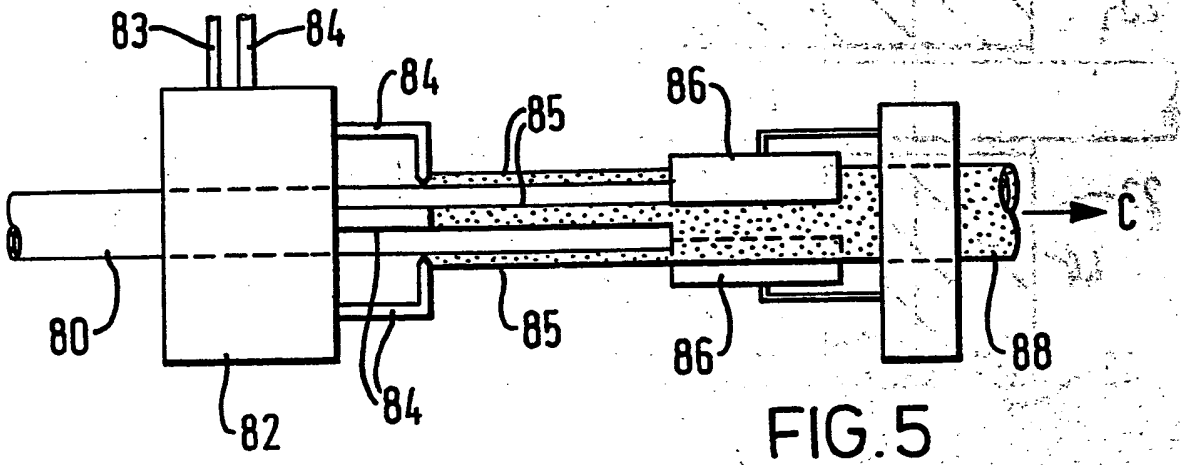
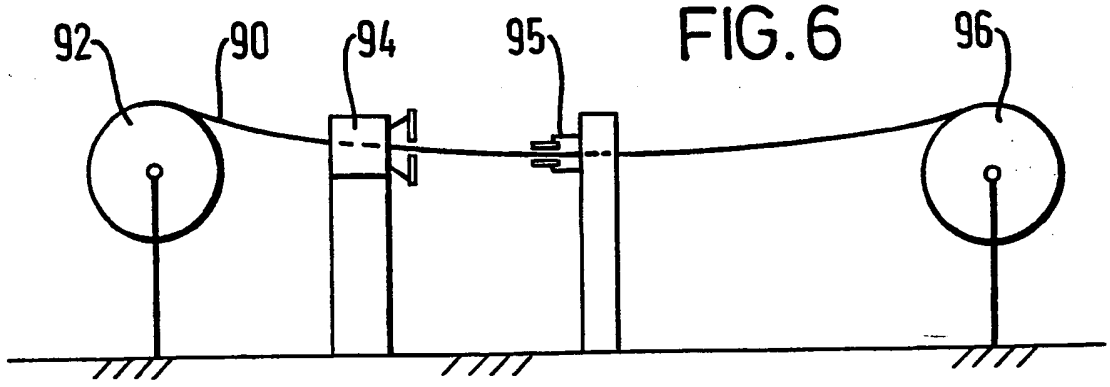


FIG.5

FIG.6



UMBILICAL STRUCTURES

This invention relates to a method of providing a protective skin around a core of an umbilical structure, and apparatus therefor.

The core of an umbilical structure may be a tubular member or an assembly of two or more tubular members held together. Such a tubular member can be, for example, an insulated jacket for one or more pipes for conveying cooled or heated media; one or more wire or fibre optic cables; or a fluid hose. Heretofore, such skins have been formed either by winding strip material helically onto a core and having a spiral overlap between each wind of strip material, or by extrusion. However, the application of strip material, particularly to a core having foamed insulation material, depresses the material and reduces a predetermined insulation factor of such insulation material. It also reduces the flexibility of any umbilical structure to which it is applied. A further disadvantage occurs in sealing and repairing joins due to provision of branch lines or any damage due to mishandling. Coating cores by extrusion is only practical and economic for large production runs as it is complicated to set up, and not readily adaptable.

An object of the present invention is to obviate or mitigate these disadvantages.

Accordingly, one aspect of the present invention is a method of providing a protective skin around a core of an umbilical structure comprising the application of one or more lines of fluent covering material to the surface of the core to form a substantially even and regular coating, followed by curing of the coating to form the skin.

The use of fluent covering material allows the material, once applied to the core, to form, either by itself or with assistance, a substantially even and regular coating and thus a skin which is continuous. Umbilical structures formed with a protective skin according to the invention have a neat appearance, they can be of any desired colour to match the surrounding decoration in the location where the structure is to be used, and they can stretch longitudinally if required without damaging the characteristics of the skin

material. The structures also have ease of application at joints or damaged locations by touching up the skin using a spray applicator with the same covering material. Insulated cores prepared by the present invention do not lose a percentage of their insulation factor and are flexible for close fitment around corners during installation.

According to a preferred embodiment of the present invention, the covering material is a two part polyurethane elastomer composition which starts to cure on mixing, and has a rapid (eg. minutes or seconds) curing time. The coating should then be dry or if not, then dried. There are many commercially available two part polyurethane compositions which fit this criteria. However, particularly preferred is the composition of one part comprising a mixture of polyols and a diol, with the other part comprising a quasi-prepolymer produced by reacting a proprietary modified diphenylmethane diiscoyanate with a polyol (for example Apollo AX.9131 Part A and B available from Apollo Chemicals Limited, Tamworth, UK - mixing ratio preferably 100: 82.7 parts by weight A : B; curing time : 20-30 seconds in 30 gramme mix)

Because of the preferred rapid curing time, the parts of the composition are preferably mixed only shortly prior to application of the composition to the core. For example, they could be mixed within the apparatus adapted to apply the composition to the core.

With rapid curing, the coated umbilical structures of the present invention can be quickly and/or directly packaged or (re)rolled. Preferably, the coating of covering material cures within minutes or seconds under normal atmospheric conditions, i.e. without assistance and in air. Preferably also, the cured coating is already dry or dries rapidly thereafter. Where it is desired or necessary, a water bath can be used to support the coated structure during curing.

Thus according to another embodiment of the present invention there is provided a continuous process for providing a protective skin around a core of an umbilical structure wherein a continuous supply of umbilical structure is coated according to a

method described herein. The continuous supply of umbilical structure may come from a reel. Preferably, the coated umbilical structure is, after curing (and drying) , directly rolled around a final reel. This continuous process is particularly suitable for e.g. insulation tubing (which is commonly rolled onto reels for transportation and storage).

Preferably, the covering material is non-solvent based to avoid environmental problems in the workplace and outside. However, solvents could be used if e.g. it is required by the composition of the covering material used, or it assists curing or drying times.

The line(s) of covering material may be of any shape or dimension, eg. bands, ribbons, etc. on the core. In a preferred embodiment of the present invention, the lines take the form of helical windings. In one arrangement of this embodiment, the helical winding(s) are applied so close together that, because the covering material is fluent, they flow into one another, coalesce, and form a continous coating around the core.

Alternatively, the helical winding(s) of applied covering material are spread substantially evenly and regularly over the whole surface of the core by one or more spreading devices. The spreading devices may be off-set about the core. Naturally, when the core and applied covering material reach the spreading devices, the material should still be fluent to at least some extent. The spreading devices preferably rotate about the core to create a more even and regular coating .

The helical winding(s) of covering material may be applied to the surface of the core by one or more applicators which rotate about the axis of the core of the umbilical structure whilst the umbilical structure is simultaneously moving in a direction along its axis. Where more than one applicator is used, each applicator is co-ordinated to intertwine its material on the core with the other applicator(s). They can also be arranged to be off-set. When it is intended that the windings coalesce, the speed of rotation of the applicator(s) are carefully matched with the rate of movement of the core along its axis to allow the helical winding(s) to be applied close together.

When the spreading devices are used, they preferably rotate in the opposite direction to the direction of rotation of the applicators. In this way, any unevenness in the distribution of covering material applied to the core eg. caused by gravity acting on the fluent material, may be counteracted. When rotating spreading devices are used, the spreading device is preferably in the form of a leaf, one end connected to the rotating means and the other end trailing on the surface of the core providing a biased compression force on the core.

The number of applicators to be used may be dependent on several factors, eg. the diameter of the core to be coated, desired thickness of skin (and hence coating), speed of manufacture, and any different/multi-coloured coatings required. Preferably, when a plurality of applicators are used they are radially located evenly around the core. This not only assists an even and regular coating around the core, but balances the forces on the core where the applicators (and spreading devices) touch or are biased against the core. For small and medium sized insulation tubing, eg. up to 100 or 200mm diameter core sizes, three or four source means may be suitable. Similar considerations apply to the number of spreading devices to be used.

The ends of the applicators applying the covering material to the core preferably touch the core and more preferably are biased against the core to ensure regular and even application of covering material on the core.

In an alternative arrangement to the applicators rotating about the umbilical structure, the umbilical structure may be rotated about its axis, whilst the applicators of covering material are stationary or are also rotating. Also, it may be the applicators which move in a direction along the axis of the core whilst the structure remains stationary in that regard.

Where a two part composition is used as the covering material, the two parts could be mixed within the applicators (e.g. by auger thread). In this way, the mixing would be immediately prior to application of the covering material to the core.

According to an alternative arrangement of the present embodiment the line(s) of covering material are applied longitudinally along the surface of the core and are spread around the core to form the coating by one or more spreading devices, followed by curing of the coating to form the skin.

The covering material and spreading devices for use in the arrangement above correspond with those discussed above. The spreading devices preferably rotate about the core to create a more even and regular coating. The longitudinal lines of covering material may be applied to the core by one or applicators. Either the umbilical structure can be drawn in a direction along its axis whilst the applicators are stationary, following which the lined structure is drawn towards the spreading apparatus, or the core is stationary and the applicators and spreading apparatus are drawn along the axis of the core.

Because the applicators for use with this arrangement of the present invention do not rotate about the core, the covering material can be supplied directly to each applicator, or each applicator can be connected to a resevoir. When it is desired to use a two part polyeurethane composition as the starting material, the two parts can be mixed in the reservoir.

Any reasonable size and shape of umbilical structure may be coated using the present invention. Naturally, circular cross-sectional structures are easier, but other shapes are possible using e.g. biased applicators.

The thickness of the protective skin may be whatever is desired or necessary. The thickness of the coating (and hence skin) can be altered by a number of factors e.g. the speed of rotation of the applicators, the speed of movement of the umbilical structure, the compression force of the spreaders on the core and the flow rate of covering material. Protective skins for insulation tubing are typically in the range 0.1mm to 0.5mm, preferably 0.12 mm to 0.25mm.

According to another aspect of the present invention, there is provided an umbilical structure having a core with a protective skin provided by a method as described herein.

According to a further aspect of the present invention, there is provided an apparatus for applying one or more helical windings of fluent covering material to a surface of a core of an umbilical structure comprising one or more applicators connected to a rotor, the rotor having at least one annular channel therein, and separate passage means to supply the covering material to each channel and from each channel to the or each applicator whereby, in use, covering material is supplied to the or each applicator as the or each applicator is rotated by the rotor around the core, and the or each applicator apply the covering material to the core whilst the core is simultaneously moving in a direction along its axis.

With the core moving simultaneously along it axis, the applied windings will be of helical form. The core may be moved by manual or mechanical means.

When it desired to use a two part composition which starts to cure on mixing as the covering material, the rotor has two separate annular channels, each separately supplied with one part of the composition, with separate passages means from each channel to the applicators. The two parts can be mixed in or by the applicators (eg. by one or more auger threads therein) prior to application to the core. The rotor may have as many separate annular channels as desired to supply separate components to the applicators, or the number of different covering materials to be applied.

In one embodiment of this aspect of the present invention, the apparatus comprises a casing, with the rotor adapted to rotate therein, two annular channels cut into the circumference of the rotor, gland means on both sides of each channel between the rotor and casing to retain the fluent material in each channel, passage means to supply each channel through the casing, one further passage means per applicator from each

channel to one face of the rotor, and separate tubing from the face of the rotor to each applicator.

Valve means can be placed in or on each applicator to control the flow of each material into the applicator, and to prevent mixture of any separately supplied materials in the applicator when not desired, eg. when the apparatus is not in operation and/or the applicator have to be cleaned or changed.

In a particularly preferred embodiment of the present invention, the umbilical structure is drawn through and is possibly supported by, the apparatus, whilst the applicators rotate thereabout.

The apparatus provides flexibility for easily adapting to different shapes and sizes of cores to be covered, and to different colours and types of covering material to be applied. The applicators can be height adjustable and/or biased against the core to accommodate different shapes and sizes of the core. With more than one applicator, different types and different colours of covering material can be supplied at the same time, the operation of which can be controlled by the valve means on the applicators. The applicators can also be designed to be easily removed for changing and/or cleaning.

Embodiments of the present invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:

Fig. 1 is a simple side view of a winding around a core according to one embodiment of the present invention;

Fig. 2 shows a side view of a covering material supplying apparatus and a spreading arrangement according to a second embodiment and modifications of the present invention;

Fig. 3 shows a cross-sectional view of the supplying apparatus of Fig. 2;

Fig. 4 shows a frontal view of the spreading arrangement similar to that of Fig. 2;

Fig. 5 shows a side view of a covering material supplying apparatus and a spreading arrangement according to a third embodiment of the present invention; and

Fig. 6 shows a schematic side view of an overall flow diagram for a preferredmethod of the present invention.

Referring to the drawings, Fig. 1 shows a core 10 of an umbilical structure, eg. the insulating cover of one or more wires or tubing therein or to be placed therein. The umbilical structure could also be simply a thin film designed to enclose and gather a number of wires or tubes. Around the core 10, a single helical winding of covering material 14, provided from an applicator 12 rotating about the core 10 (by means not shown), is applied as the core is being moved along its axis in a direction A. By matching the speed of rotation of the applicator 12 around the core 10 and the rate of movement of the core 10 in the direction A, the helical windings 14 are applied so close to one another that because the covering material from the applicator 12 is fluent, the windings 14 flow into one another, coalesce and form a continuous coating 16 around the core 10.

Fig. 2 shows a side view of other embodiments of the present invention. Fig. 2 shows a core 20 of an umbilical structure being drawn in the direction B by drawing means (not shown). The core 20 first passes through the hollow centre 21 of covering material supplying apparatus 22. The covering material is a two-part composition, each part of which is separately supplied to a mixer and applicator (hereinafter "applicator") 24 through pipes 26 and 27 and valve 33. Valve 33 controls the flow of the material from pipes 26 and 27 into the applicator 24. When the valve 33 is closed, eg. when the apparatus of Fig. 2 is not in use, no mixed, and hence cured, covering material remains in the applicator 24 and blocks it for future use. The applicator 24 can also then be easily removed or cleaned without spillage. The applicator 24 has a double auger thread which sufficiently mixes the two parts before they are applied to core 20. In Fig. 2, a rotor 23 within apparatus 22, pipes 26,27 and mixer and applicator means 24 (attached by arm 25) all rotate around core 20 to provide a helical winding 28 on the longitudinally moving core 20. Fig. 2 shows a second mixer and applicator 29 attached via pipes 26', 27' and valve 33' to the rotor 23 of apparatus 22. As many mixer and applicators can be used as

From each channel 44,45 there are hollow passages 48,49 respectively to the face of the rotor 23 to which the pipes 26 and 27 and arm 25 are attached. Arm 25 supports the applicator 24. One hollow passage from each channel is required per mixer and applicator. As many hollow passages as can be accommodated in rotor 23 may be made. Thus each part of the covering material composition is fed separately through valve means 33 into the applicator 24 by separate hollow passage and pipe (eg. 48,26), and mixture and therefore reaction and curing of the two parts only occurs immediately prior to application of the covering material to the core 20. This ensures that the material is still fluent upon application.

The mixer and applicator 24 has a double auger thread 50. The thread 50 is freely or low friction rotatably, and rotates because of passage of the covering material therethrough. Provided it is sufficiently long, the thread 50 serves to mix the two parts of the covering material coming from pipes 26 and 27 sufficiently prior to their application to the core 20 through a nozzle 52 of applicator 24. The auger thread 50 also serves to feed constantly the nozzle 52 with a regular supply of mixed material. The nozzle 52 can simply touch the core 10, or be pressed against it to create a biasing force upon rotation of the applicator 24. If necessary or desired, a part of applicator 24 could be made flexible (eg. a concertinaed section) to assist the biasing action.

Fig. 4 shows a frontal view of four spreaders 72, arms 76, rotor 74 and housing 75 similar to the spreaders 32 et al in Figure 2 above. The rotor 74 rotates the arms 76 and spreaders 72 around a core 70. Because the existing edges of the spreaders 72 lie against the core 70, the rotating spreaders 72 spread the covering material (not shown) on the core 70 into a substantially even and regular coating around the whole of the core 70 prior to its curing.

Fig. 5 shows a side view of a core 80 of an umbilical structure being drawn in direction C by drawing means (not shown). The core 80 first passes through the hollow centre (not shown) of covering material supplying apparatus 82. The covering material is

are desired or necessary or can be accommodated on the rotor 23. Each part of the two part covering material composition is supplied separately to the apparatus 22 by pipes 30 and 31. Further details of apparatus 22 are shown in Fig. 3 discussed below.

After windings 28 of covering material have been applied to the core 20, the core passes through a set of spreaders 32, two of which are shown in Fig. 2 although more are possible if desired or necessary. The spreaders 32 need not be parallel with the core surface. They are attached to arm means 36 which are rotated by rotor 34 in a housing 35 about the core 20. The trailing edges of the rotating spreaders 32 lie against the core 20 and thus serve to spread the windings 28 into a substantially even and regular coating 38 around the whole of the core 20, which subsequently cures to provide a protective skin on the core 20. A cross-sectional view of a four spreader arrangement is shown in Fig. 4 below.

In the apparatus shown in Fig. 2, with three rotating applicators and four spaced spreaders, the rotation speed of the applicators can be 200 rpm, and the rotation speed of the spreaders can be 400 rpm. The draw speed (speed of movement of the umbilical structure in direction B in Fig. 2) can be 3-10m/min. To produce a protective skin of approximately 0.12mm thickness around a core of 40mm diameter, the rate of flow of covering on the core (through all applicators) can be 25-50 grams/min.

Fig. 3 shows a cross-sectional view of the covering material supplying apparatus 22 and mixer and applicator 24 and pipes 26,27 of Figure 2. The apparatus 22 has a stationary casing 40 surrounding a rotor 23. A motor (not shown) rotates rotor 23 within the casing 40 using bearings 42. Around the circumference of rotor 23 are two cut annular channels 44 and 45 into which each part of the covering material is separately fed (under pressure) by pipes 30 and 31 respectively. Material in the channels 44,45 is prevented from escaping from the apparatus 22 by means of glands 46, eg. O-rings, on both sides of each channel. The glands are designed to fit snugly between the circumference of the rotor 23 and the inner surface of casing 40.

a two part composition, each part of which is separately supplied to the apparatus 82 by pipes 83 and 84, before being mixed in a resevoir (not shown) in the apparatus 82. Covering material from the resevoir of the apparatus 82 is applied to the core 80 by applicators 84. As the core 80 is being drawn, the material is applied in the form of longitudinal lines 85. The core 82 then passes through a set of spreaders 86, similar in form and arrangment to the spreaders shown in Figures 2 and 3 above. The spreaders 86 spread the lines 85 to form a substantially even and regular coating 88 around the whole of the core 80, which subsequently cures to provide a protective skin on the core 80.

Figure 6 shows a schematic side view of an overall flow diagram for a preferred method of the present invention. The method comprises the sequential steps of feeding a length of core 90 from a first reel 92 to a covering material supplying apparatus 94 where covering material is applied to the core 90. The core 90 and covering material are then passed through a set of rotating spreading devices 95 which assist in creating a substantially even and regular coating on the core 90.

Thereafter, the coating on the core 90 cures in the air before being rolled onto a reel 86. If necessary or desired, a water bath may be added to support the core 90 during curing of the coating before the core 90 is rolled onto reel 96. This method is preferably continuous for as long as core 90 is supplied.

Variations and modifications can be made without departing from the scope of the invention described above and as claimed hereinafter.

CLAIMS

1. A method of providing a protective skin around a core of an umbilical structure comprising the application of one or more lines of fluent covering material to the surface of the core to form a substantially even and regular coating therearound followed by curing of the coating to form the skin.

2. A method as claimed in Claim 1 wherein the covering material is a two part polyurethane composition which starts to cure on mixing.

3. A method as claimed in Claim 2 wherein the two parts of the composition are mixed immediately prior to application thereof to the surface of the core.

4. A method as claimed in any one of Claims 1 to 3 wherein the coating cures in air.

5. A method as claimed in any one of the preceding Claims wherein the covering material is non-solvent based.

6. A method as claimed in any one of the preceding claims wherein the or each line is a helical winding.

7. A method as claimed in Claim 6 wherein the or each helical winding is applied close together so that they coalesce and form a continuous coating around the core.

8. A method as claimed in Claim 6 wherein the applied covering material is spread substantially evenly and regularly around the surface of the core by one or more spreading devices.

9. A method as claimed in Claim 8 wherein the or each spreading device rotates about the axis of the core.

10. A method as claimed in any one of Claims 6 to 9 wherein the helical winding(s) of covering material are applied to the surface of the core from one or more applicators which rotate about the axis of the core whilst the umbilical structure is simultaneously moving in a direction along its axis.

11. A method as claimed in any one of Claims 1 to 5 wherein the or each line is applied longitudinally along the surface of the core, and the or each line is spread around the core to form the substantiually even and regular coating by one or more spreading devices.

12. A method as claimed in Claim 11 wherein the or each spreading device rotates about the axis of the core.

13. A method as claimed in Claim 11 or Claim 12 wherein when the covering material is a two part composition, the two parts are mixed in a reservoir which supplies the covering material for the lines.

14. A method of continuously providing a protective skin around a core of an umbilical structure wherein a continuous supply of umbilical structure is coated according to a method as described in any one of Claims 1 to 13.

15. A method as claimed in Claim 14 wherein the umbilical structure is supplied from a first reel, and after curing, the coated umbilical structure is rolled onto a second reel.

16. A method as claimed in any one of the preceding Claims wherein the umbilical structure is insulation tubing.

17. An umbilical structure having a core with a protective skin whenever prepared according to any one of Claims 1 to 16.

18. Apparatus for applying one or more helical windings of fluent covering material to a surface of a core of an umbilical structure comprising one or more applicators connected to a rotor, the rotor having at least one annular channel therein, and separate passage means to supply the covering material to each channel and from each channel to the or each applicator whereby, in use, covering material is supplied to the or each applicator as the or each applicator is rotated by the rotor around the core, and the or each applicator applies the covering material to the core whilst the core is simultaneously moving in a direction along its axis.

19. Apparatus as described in Claim 18 wherein when the covering material is a two part composition, the rotor comprises two separate annular channels, each separately supplied with one part of the composition, with separate passage means from each channel to the or each applicator.

20. Apparatus as claimed in Claim 19 wherein the two separate parts of the composition are mixed in the or each applicator prior to application of the composition to the core.

21. Apparatus as claimed in any one of Claims 18, 19 or 20 wherein the or each applicator includes valve means to control the flow of the or each material into the or each applicator.

22. Apparatus as claimed in any one of Claims 18 to 21 comprising a casing, with the rotor adapted to rotate therein, two annular channels cut into the circumference of the rotor, gland means on both sides of each channel between the rotor and the casing to retain the fluent material in each channel, passage means to supply each channel through the casing, one further passage means per applicator from each channel to one face of the rotor, and separate tubing from the face of the rotor to each applicator.

23. An umbilical structure having a core with a protective skin whenever prepared by apparatus according to any one of Claims 18 to 22.

24. A method of providing a protective skin substantially as hereindescribed with reference to Figure 1.

25. A method of providing a protective skin substantially as hereindescribed with reference to Figures 2 to 4.

26. A method of providing a protective skin substantially as hereindescribed with reference to Figure 5.

27. A method of providing a protective skin substantially as hereindescribed with reference to Figure 6.

28. An umbilical structure having a core with a protective skin substantially as hereindescribed with reference to Figure 1.

29. An umbilical structure having a core with a protective skin substantially as hereindescribed with reference to Figure 2.

30. An umbilical structure having a core with a protective skin substantially as hereindescribed with reference to Figure 5.

31. Apparatus for applying one or more helical windings substantially as hereindescribed with reference to Figures 2 and 3.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) -17-

Application number
GB 9415505.8

Relevant Technical Fields

(i) UK Cl (Ed.M) B2L (LCEA, LCEC)

(ii) Int Cl (Ed.5) B05C 5/02; B05D 1/00, 1/26

Search Examiner
MR G J W RUSSELL

Date of completion of Search
10 OCTOBER 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-31

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 1369612	(ICI) see page 2 lines 25-33	1, 18
X	GB 913685	(SUNDES FABRIKKER) see page 2 lines 27-57	1-7

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